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ALASKAN SEAFOOD PROCESSING

Environmental Protection Agency
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REGION X

SURVEILLANCE AND ANALYSIS DIVISION

ALASKAN SEAFOOD PROCESSING

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ENVIRONMENTAL
PROTECTION
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REGION X

WORKING PAPER NO. 83

ALASKAN SEAFOOD PROCESSING

Prepared By

Craig Vogt

Working Paper No. 83

June 1973

U.S. Environmental Protection Agency
Region X
Surveillance and Analysis Division
Technical Support Branch
Technical Studies Section

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STATEMENT OF PROBLEM

Statement of Problem

Seafood processing constitutes one of Alaska's major industries and is also one of the major waste sources in the coastal areas. Waste quantities from seafood processing range from 30-80% of the weight of raw product. In most cases, these wastes are discharged directly to adjacent receiving waters with little or no treatment. In recent years concern has risen over the possible adverse environmental effects from these operations. Concentrations of seafood processing activities such as that found at Kodiak have produced severe water quality degradation.

A real need exists to develop better information on which to base actions leading to reductions in pollution.

Purpose

One of the primary inputs needed to support development of pollution control requirements for the seafood processing industry in Alaska is a basic understanding of what is there now. At the present time there are over 200 seafood processing installations in Alaska, many of them located in extremely remote areas. At the time of this study no one in either the State pollution control agency or in EPA has any overall knowledge regarding locations, waste disposal practices and effects upon receiving waters for the majority of the processors. With this in mind, the State of Alaska requested EPA to conduct a general reconnaisance of existing waste disposal methods and any attendant environmental problems at selected processing facilities in Alaska. The processors visited were selected as

representative of (1) the larger seafood processors in the state and (2) types of location (bays, inlets, rivers, remote locations, several processors in one area, etc).

Since the survey was conducted nearly two years prior to publication of this report, it should be pointed out that conditions have not been reviewed since the survey and some differences in current operations and environmental effects may exist. EPA conducted this survey during the Summer of 1971. Seafood processors in the City of Kodiak were not included in this survey as Kodiak processors have been previously surveyed. Thus, findings, conclusions and recommendations in this report do not concern the processors at Kodiak.

Objectives

The specific objectives of the survey were:

1. To obtain information of seafood waste quantities and methods of waste disposal.

2. To make visual observations of environmental effects resulting from waste disposal and identify, on a priority basis, those areas and/or specific processors needing further investigation.

It was not the objective of this survey to develop recommendations as to the adequacy of or the need for specific treatment methods. Decisions on specific treatment requirements will be based on the observations from this survey, data obtained during subsequent investigations, and application of waste treatment guidelines developed under Section 306 of the Federal Water Pollution Control Act.

Findings and Conclusions

1. Three basic methods for disposal of seafood wastes were observed during the survey:

a. Discharging wastes whole either by dropping through holes in the floor or by fluming to the dock face. Of the 32 processors visited, nine used this method.

b. Grinding wastes and discharging at the dock face or at depth through an outfall pipe. Grinding was practiced by 19 of the 32 sampled.

c. Barging whole wastes away from the vicinity of the plant and dumping in deeper water. This method was used by four of the 32 processors visited.

2. The environmental problems associated with Alaskan seafood processing result from:

a. The extremely high percentage by weight of waste in seafood processing.
Salmon are 33-45% waste, crabs are 75-80% to 88% waste, and shrimp are 80-85% waste.

b. The relatively short salmon canning season which results in large quantities of waste being discharged during a short time interval.

c. The limited number of waste disposal alternatives that are available. Many seafood processors are at remote locations where possibilities of landfilling seafood wastes appear to be very limited.

3. Waste discharges from many Alaskan seafood processors that were visited were causing environmental damage in receiving waters and violating Alaskan Water Quality Standards. The environmental damage was evidenced by:

a. Accumulations of seafood wastes on the bottom resulting in

sludge beds and associated problems.

b. Aesthetically degrading conditions such as bloody water, accumulations of seafood wastes on the beaches, and foam and floating seafood wastes on the water surface. These aesthetic problems exist at nearly all locations visited.

The severity of environmental effects as listed above depends upon the size of operation, methods of waste disposal, plant location, tidal effects, and currents.

Of the areas visited, dredge samples and visual observation indicated that significant water quality problems as a result of seafood processing may exist at the following areas: Cordova, Dutch Harbor, Orca and Naknek River.

Recommendations

1. Additional field investigations should be conducted at Cordova, Dutch Harbor, Orca, and Naknek River to document the extent of water quality degradation associated with these areas of concentrated seafood processing activities.

2. Studies should be conducted at selected isolated locations to determine the impact of single processors on water quality. Recommended study areas are Chignik, King Cove, Uganik Bay, Chatham, Orca, and Cordova.

SEAFOOD PROCESSING, SOURCES AND QUANTITIES OF WASTE

Salmon Industry

Depending upon the general area in Alaska in which salmon canneries are located, the canneries process any or all of the following species of salmon: sockeye (red), pink (humpback), chum (dog), coho (silver), and chinook (king). Salmon processing seasons generally last around two months. One example of an extremely short season is in the Naknek River area where salmon are processed during a period of one month with 50% of the annual production being completed in one week. The other extreme is in Southeastern Alaska and the Prince William Sound area where the season may extend for nearly six months from May through October. The length of seasons and species of salmon that are processed by the salmon processors visited are shown in Table I.

Salmon Processing. Salmon are usually unloaded from the fishing boats by pumping salt water into the fish holds and making a "salmon and water slurry." The salmon are then pushed out of the boats into elevators. The elevator dewaters the salmon and lifts the fish to a conveyor. The fish are then conveyed to the fish house where they either go directly to the butchering area or to the storage bins where the fish are frequently cooled by either ice or a refrigerated brine for later processing. At the time of processing, the fish are transported from the storage bins to the butchering area by either conveyor belt or sluiced with salt water.

TABLE I

SALMON INDUSTRY

Codes	Company Location	Season	# of Months	# of Processing Days	Tidal Range	Currents Past Cannery	Salmon Processed Pinks	Sockeye	Chums	Coho	Chinook
1, 3, 5	Peter Pan Seafoods False Pass	June 10 - Aug. 15	2-1/4	60	-	2-4mph	19%	65%	16%		
1, 3, 5	Peter Pan Seafoods King Cover	June 7 - Aug. 15	2-1/4	60	-	-	55%	25%	20%		
1, 3, 5	Alaska Packers Assn. Chignik	June 15 - Aug. 15	2	50	-	-	35%	50%	10%	5%	
1, 3, 5	Alaska Packers Assn. Larsen Bay	June 2 - Aug. 11	2-1/2	45	16'	-	82%	15%	3%		
1, 3, 5	New England Fish Co. Uganik Bay	July 5 - Aug. 23	1-3/4	35	15'	-	85%	6%	6%	3%	
1, 3, 5	Peter Pan Seafoods Hawk Inlet	July 1 - Sept. 1	2	36	-	-	80%		10%		
1, 3, 5	New England Fish Co. Chatham	July 1 - Sept. 1	2	40	15'	-	80%	4%	12%	4%	
1, 3, 5	Peter Pan Seafoods* Excursion Inlet	July 5 - Aug. 31	1-3/4	35	20'	2-4 mph	72%	9%	16%	3%	
1, 4	Columbia Ward Fisheries Ekuk	June 15-Aug. 14	2	35	20'	-	5%	90%	5%		
1, 4	Orca Pacific Packing Orca	May 15-Aug. 15	3	44	12'	-	60%		20%		
2, 4	St. Elias Ocean Products Cordova	May 15-Aug. 10	3	54	12'	-	35%	30%	10%	22%	3%

* 35% of fish heads sold for pet food.

TABLE I (Cont.)

SALMON INDUSTRY

Codes	Company Location	Season	# of Months	# of Processing Days	Tidal Range	Maximum Currents Past Cannery	Salmon Processed				
							Pinks	Sockeye	Chums	Coho	Chinook
2, 4	Pt. Chehalis Packers Cordova	May 15 - Oct. 15	5	76	12'	-	50%	25%	10%	10%	3%
2, 3	Whitney Fidalgo ** Petersburg	April 15 - Oct. 15	6	104	15'	2 mph	55%	10%	25%	10%	
2, 3	Petersburg Fisheries Petersburg	June 20 - Oct. 5	3-1/2	96	15'	2 mph	75%	7%	15%		3%
2, 5	Columbia Ward Fisheries Naknek River	June 22 - July 19	1	24	20'	2 mph		98%	2%		
2, 5	Nelbro Co. Naknek River	June 15 - July 15	1	20	20'	2 mph		96%	1%		3%
2, 5	Alaska Packers Assn. Naknek River	June 26 - July 23	1	24	20'	2 mph		98%	2%		
2, 5	Bumble Bee Seafoods Naknek River	June 22 - July 20	1	18	20'	2 mph		98%	2%		
2, 5	Whitney Fidalgo Naknek River	June 15 - July 18	1	28	20'	2 mph		98%	2%		
1, 5	Peter Pan Seafoods Dillingham	June 3 - Aug. 2	2	35	-	-	6%	71%	20%		3%

* 35% of fish heads sold for pet food.
** Includes wastes from processing 800,000 lbs. of Halibut

CODES

1. Processor is isolated
2. Several processors located in same area
3. Located on small bay, cove, inlet
4. Located on large bay
5. Located on an estuary

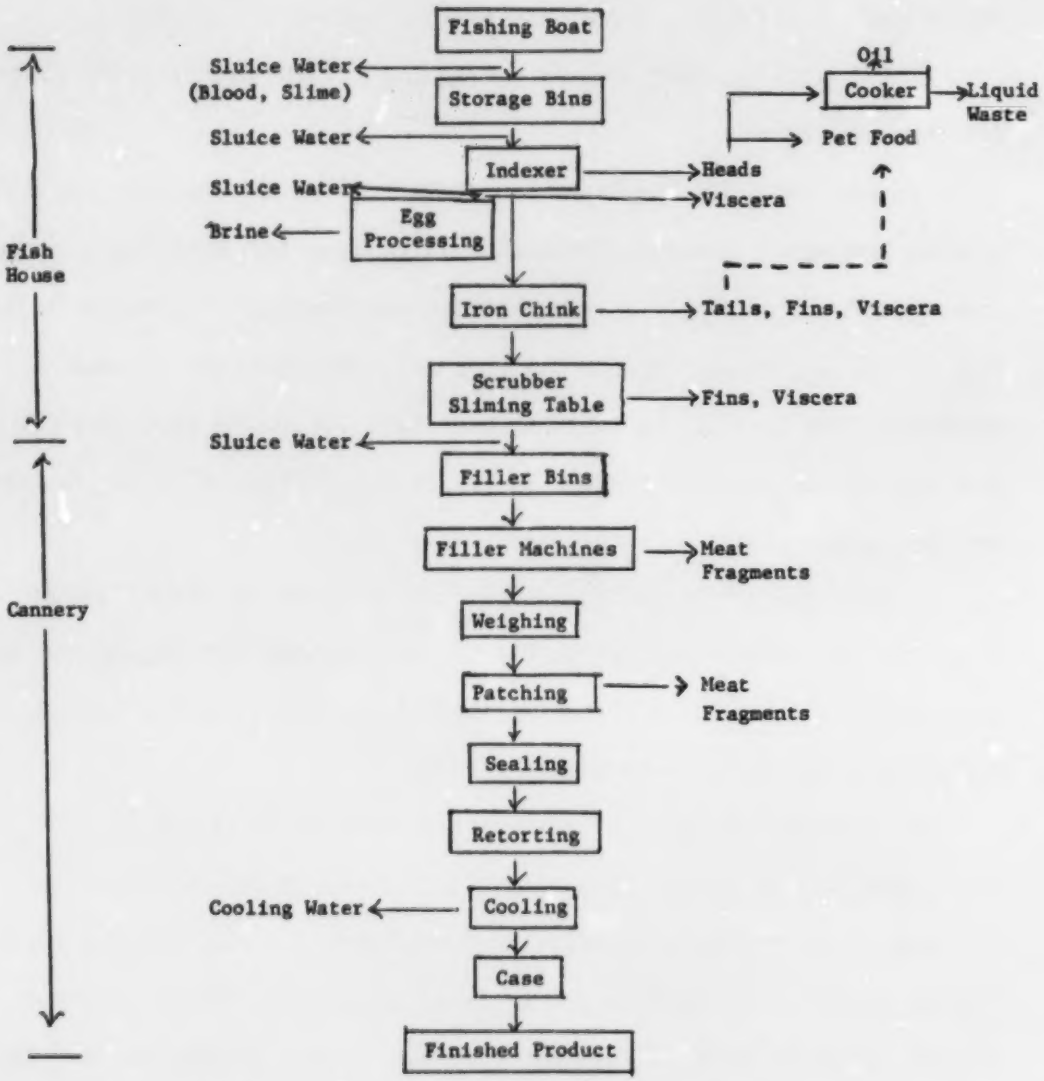
In the butchering area, the salmon are prepared for canning. Fish heads are removed by the indexer which is frequently referred to as the header. After the heads are removed, the belly of the fish is cut open and the eggs removed by hand. The "iron chink" then removes the tails, fins and viscera. Any remaining fins or viscera are then removed from the fish by hand at the sliming table. The fish are then conveyed to the canning area, referred to as the cannery.

In the cannery, the fish are stored briefly in bins before being cut into sections by a machine and forced by the filler machine into cans which are either 1/4, 1/2, or 1 pound net weight. At this point some canneries add salmon oil to the cans of salmon, derived from the rendering of salmon heads by pressure cooking. The cans are then weighed and off weight cans are adjusted to weight by hand at the patching table. Finally, the cans are sealed, retorted, and cased into 24 and 48 pound cases.

The salmon eggs which are pulled from the fish just prior to the "iron chink" are flumed to what is termed the egg house. In the egg house, eggs are processed in vats containing 200 - 250 gallons of a 100 ppm solution of sodium nitrite which acts as a color preservative. After approximately 45 minutes in the brine, the eggs are removed, salted, and packed for shipment to Japan where the eggs are consumed as caviar.

The above salmon processing operations are flow charted in Figure 1.

Figure 1


Fishing Boat
Sluice Water
(Blood, Slime)
Storage Bins
Oil
Cooker
Liquid Waste
Sluice Water
Pet Food
Indexer
Heads
Sluice Water
Viscera
Egg Processing
Brine
Fish House
Iron Chink
Tails, Fins, Viscera
Scrubber Sliming Table
Fins, Viscera
Sluice Water
Filler Bins
Filler Machines
Meat Fragments
Cannery
Weighing
Patching
Meat Fragments
Sealing
Retorting
Cooling Water
Cooling
Case
Finished Product

Sources of Waste. The major source of wastes is in the butchering area of the fish house where heads, tails, fins, and viscera are removed by the indexer, iron chink, and at the sliming table.

In the cannery, meat fragments from the fillers and patching table are the major sources.

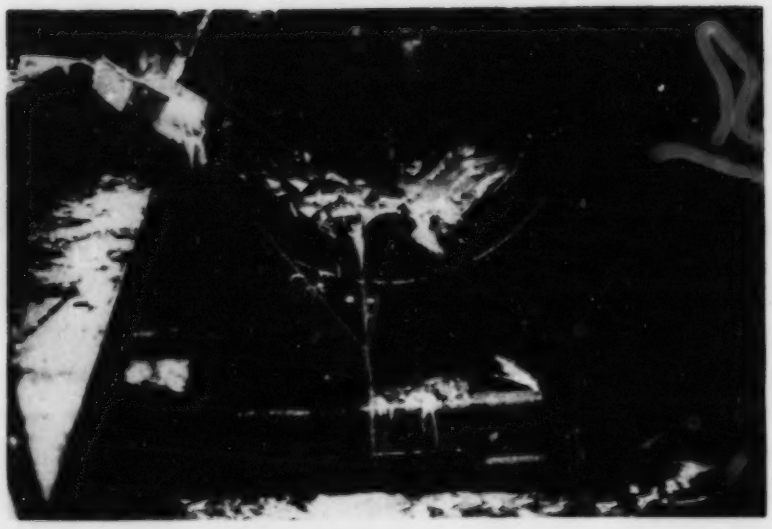
The egg house usually has only one type of waste, the brine used to process the eggs. However, frequently in pulling eggs from the salmon, some viscera is also pulled from the fish and transported along with the eggs to the egg house. Before the eggs are processed, the viscera is separated from the eggs and discharged. Most egg houses have three to five egg processing vats containing 200 to 250 gallons of brine, and these are discharged either daily or every other day.

As mentioned in a previous section, some canneries render salmon heads for oil. After rendering, the oil is filtered and transported to the cannery and the wastes from the rendering process are discharged. The waste is a viscous, red-orange liquid.

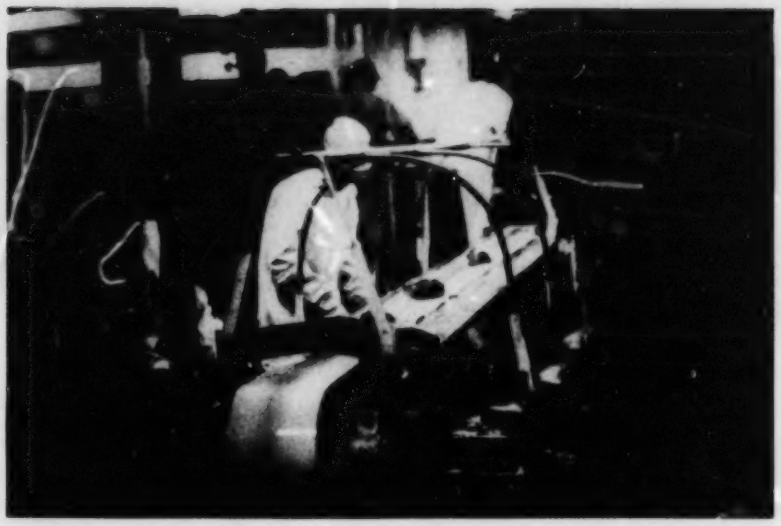
The sources and types of waste are also shown in Figure 1.

Quantities of Waste. The quantities of salmon processing wastes for each plant visited were calculated from annual production and recovery figures supplied by plant superintendents and company offices. These figures shown in Table II, are based on the largest production year for each specific processor within the last five years of available data. Recovery figures indicate the amount of a whole salmon that ends up in the can and are given in pounds of round (whole) salmon per 48 pound case (net weight) of canned salmon. The annual chemical oxygen demand (COD) and total dry solids were calculated using the annual production figure

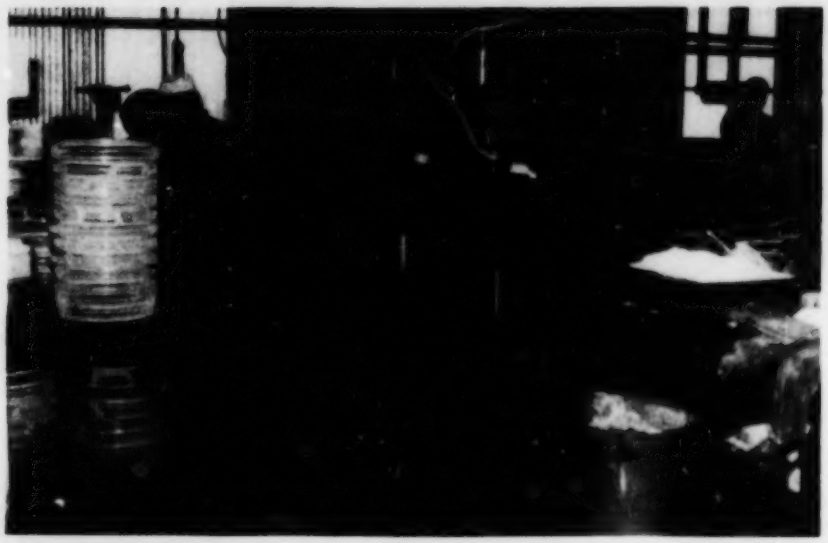
Preparing to Unload Salmon from Scow



"Iron Chink" and Resulting Salmon Wastes. The iron chink removes tails, fins, and offal.



Sliming Table. Removal of any remaining waste portions (fins, offal, and tails) after the salmon have been through the "iron chink".



Egg House. Salmon eggs are processed in the vats and later salted and packed for shipment.

TABLE II

Salmon Processor's Waste Quantities

Company - Location	Waste Disposal Methods	Cases ** Produced	Recovery lbs rd fish/case	Raw Fish Processed (lbs)	Waste Quantities (lbs)					
					Wet Weight		COD		Total Dry Solids	
					Annual	Daily	Annual	Daily	Annual	Daily
Alaska Packers Assn. Chignik	Barging, 2½" nylon mesh	170,000	79	13,430,000	5,270,000	107,000	537,000	11,000	940,000	19,000
Larsen Bay	Barging, wood siding	120,000	85.5	10,260,000	4,500,000	100,000	410,000	9,000	718,000	16,000
Naknek River	Grinding, outfall under dock	180,000	75	13,500,000	4,870,000	203,000	540,000	22,000	945,000	39,000
Bumble Bee Seafoods Naknek River	Outfall under dock-Heads cooked	132,000	73	9,636,000	3,300,000	184,000	385,000	21,000	675,000	37,000
Columbia Ward Ekuk	Grinding, outfall under dock	30,000	69	8,970,000	2,730,000	78,000	359,000	10,000	628,000	18,000
Naknek River	Grinding Heads Holes in Floor	NA*	NA	NA	NA	NA	NA	NA	NA	NA
New England Fish Chatham	Grinding, discharge at depth, 450' out	140,000	83.2	11,648,000	4,900,000	123,000	466,000	12,000	815,000	20,000
Orca	Grinding, dishcarge 800' out on surface	212,000	80.5	17,066,000	6,900,000	157,000	683,000	16,000	1195,000	27,000
Uganik Bay	Grinding, discharge 300' out at depth	155,000	83.6	12,958,000	5,520,000	158,000	518,000	15,000	907,000	26,000
Nelbro Packing Naknek River	Grinding, discharge	113,000	71	8,023,000	2,600,000	130,000	321,000	16,000	562,000	28,000

* Not available at this time

** Largest production year within last five years

TABLE II (Cont.)

Company - Location	Waste Disposal Methods	Cases ** Produced	Recovery lbs rd fish/case	Raw Fish Processed (lbs)	Waste Quantities (lbs) Wet Weight Annual	Wet Weight Daily	COD Annual	COD Daily	Total Dry Solids Annual	Total Dry Solids Daily
Peter Pan Seafoods Dillingham	Grinding all wastes Discharged at depth 200' out	82,000	78	6,400,000	2,440,000	70,000	256,000	7,300	448,000	12,800
Excursion Inlet	Freeze Heads, outfall 80' out	167,000	79.3	13,240,000	5,220,000	149,000	530,000	15,000	927,000	26,500
False Pass	Cook Heads, Tails, Fins-Viscera discharged under dock	159,000	74.3	11,800,000	4,180,000	70,000	474,000	7,900	829,000	13,800
Hawk Inlet	Barging, 2½" nylon mesh	108,000	79.4	8,580,000	3,390,000	94,000	343,000	9,500	600,000	16,700
King Cove	Barging, wood barge	228,000	80	18,240,000	7,290,000	122,000	730,000	12,100	1,280,000	211,300
Petersburg Fisheries Petersburg	Outfall at dock face	123,000	79.5	9,780,000	3,880,000	40,000	391,000	4,100	684,000	7,100
Point Chehalis Packers Cordova	Freeze heads, outfall under dock	75,000	80.5	6,040,000	1,630,000	21,000	242,000	3,200	423,000	5,600
St. Elias Ocean Products Cordova	Grinds heads only, outfall in boatside		39	2,970,000	1,160,000	21,000	119,000	2,200	208,000	3,800
Whitney Fidalgo Seafoods Naknek River	Grinding, outfall under dock	67,000	75	5,030,000	1,810,000	65,000	201,000	7,180	315,750	12,600
Petersburg	Freeze heads	50,000	84	4,200,000	2,070,000+	17,000+	168,000+	1,620+	294,000+	2,800+

** Largest production year within last five years.

and values of 0.04 and 0.07 respectively, for COD and total dry solids associated with each pound of salmon processed. Solids and COD factors were developed from data collected during an unpublished waste characterization study in 1968 by EPA and are considered to be conservative. Daily waste figures were calculated from annual waste figures and operating data given to the EPA by plant superintendents and company offices.

The calculated waste quantities in Table II should be considered as estimates because of the following:

(1) Production figures were rounded off by many of the superintendents and company offices.

(2) Recoveries vary from season to season.

(3) The fishing season varies greatly in length from year to year.

(4) Many superintendents and company offices could estimate number of days operating during the season only in terms such as: "about 4 to 5 days per week" or "from 70 to 90% of the season."

(5) The number of fish caught daily varies tremendously and thus the number of hours each day that salmon are processed varies accordingly. Frequently 50% of all the salmon processed during a season are processed within 20% of the season.

Recovery figures for each salmon species are shown in Table III as reported by plant superintendents and company offices.

1/ These processor's waste quantities are pointed out because several processors are discharging into the same bay or estuary.

2/ Data available only from four of the five processors discharging into the Naknek River.

3/ Data available only from two of the three processors located in Petersburg.

The quantities of water used to process salmon were difficult to determine and generally unknown by the processors. Of the 20 salmon processors visited, only two metered their water supply. Data from one of these indicated that approximately 125 gallons of fresh water were used to produce one 48 pound (net weight) case of canned salmon which translates to 1.75 gallons of fresh water per pound of fish processed. Most salmon processors that were visited roughly estimated their total water usage (salt and fresh water) from 0.4 mgd to 1.5 mgd.

Reduction of Waste Quantities. Ideally, complete utilization of the salmon by converting wastes into a useful by-product such as pet food would eliminate the problems associated with waste disposal. The value of salmon processing wastes as nutrients in the marine environment, however, has not been completely determined. An evaluation comparing the benefits to the aquatic life of properly treated and discharged wastes versus the benefits of utilizing all wastes by conversion to products such as pet food is needed.

Presently the marketability of salmon wastes is limited by large freight expenses from Alaska to the contiguous United States. For the past several years, a few salmon processors have been grinding and freezing salmon heads for use in pet food, but the market dropped in 1971, and several processors discontinued freezing

Table III

Salmon Waste

Salmon Species	lbs. round fish case (48 lbs)	lbs. waste case (48 lbs)	% waste
Pink	85 - 87	37 - 39	43.5 - 45%
Sockeye	72 - 76	24 - 26	33 - 34
Chum	78 - 80	30 - 32	38.5 - 40
Silver	77 - 78	28 - 29	36 - 37
King *	91	43	47

* Figures based only upon one processor.

The following two tables were derived from Table II:

Table IV

Estimated Annual Waste from Salmon Processors in Pounds

Location	# of Processors	Wet Weight	COD	Total Dry Solids
Naknek River[1/]	4 [2/]	12,600,000	1,450,000	2,530,000
Cordova [1/]	2	2,780,000	360,000	630,000
Petersburg [1/]	2 [3/]	5,950,000	559,000	979,000

Table V

Estimated Daily Waste from Salmon Processors in Pounds

Location	# of Processors	Wet Weight	COD	Total Dry Solids
Naknek River[1/]	4 [2/]	582,000	67,000	118,000
Cordova [1/]	2	43,000	5,000	9,000
Petersburg	2 [3/]	58,000	6,000	10,000

ground fish heads and were discharging them as wastes. The fish heads and collars contain a great deal of meat and make up approximately 57% of the total waste. The waste composition of pink and red salmon are shown in Table VI. Fish eggs are now being utilized and if the heads and collars were also utilized, the waste discharge streams would be reduced by around 65-68% from past levels and 56-59% from present levels.

Table VI

Waste Composition - Pink and Red Salmon *

	Pink	Red
Heads and collars	56.6%	58.6%
Fins	9.1%	6.7
Tails	7.2	7.7
Eggs	8.3	9.9
Milt	4.6	5.2
Viscera (heart, liver, digestive tract)	14.2	11.9

* Magnuson and Hagevig. Comm. Fisheries Review, Vol. 12 #9, 1950

Crab Industry

Ten crab processors were visited during the survey, and four of the ten were operating aboard ships of various sizes. Only the processors in the Aleutians were operating at the time of the EPA visit and observations of methods of waste disposal were limited to these processors. King crab and some tanner crab are processed in the Aleutians; while king, tanner, and dungeness crab are processed on Kodiak Island, in the Prince William Sound area, and in Southeastern Alaska.

Crab processing seasons and type of locations are shown for each processor visited in Table VII.

Crab Processing and Sources of Waste. Crabs are kept alive in holding tanks (live tanks) or in baskets over the side of the floating processors until they are processed. In a crab meat or section line, the live crabs are butchered by hand to remove backs and viscera. The crab legs and shoulders are then cooked in either salt water or in fresh water. Following cooking, the legs and shoulders are cooled in water, washed, and remaining viscera and gills are removed. The legs, claws, and shoulders are then separated from each other, and the meat is extracted by hand picking or by putting the shells through rollers which squeeze the meat out of the shells. The resulting meat is inspected and any shell fragments are removed. The meat is packed for freezing and shipment or packed in cans which are then sealed, retorted, cooled and cased.

Table VII

Crab Industry

Code *	Company Location	** Season	# of Months	# of Processing Days
	Vita Food Products (M/V Viceroy)			
2, 3	Adak	Nov. 1 - March 31	5	105
2, 3	Dutch Harbor	July 12 - Oct. 21	4-1/4	70
	Pt. Adams Packing (M/V Northgate)			
2, 3	Adak	Nov. 1 - March 31	5	105
2, 3	Dutch Harbor	July 1 - Sept. 30	3	63
	Pan Alaska Fisheries			
2, 3	UnAlaska	July - March	9	150
	American Freezerships (M/V Terresa Lee)			
1, 3	Akutan	July 22 - Oct. 30	3-1/4	64
2, 3	Adak	Nov. 1 - Feb. 15	3-1/2	69
	Wakefield Fisheries (M/V Akutan)			
1, 3	Akutan	July 8 - Oct. 15	3-1/4	64
2, 3	Adak	Nov. 1 - March 15	4-1/2	90
	Wakefield Fisheries			
1, 3	Sand Point	Year Round	12	182
	Peter Pan Seafoods			
1, 3, 5	King Cove	Aug. 20 - Feb. 15	5-3/4	89
	Whitney Fidelgo			
2, 3	Petersburg	Aug. 1 - Feb. 15	6-1/2	56
	Pt. Chehalis Packers			
2, 4	Cordova	Jan. 1 - Nov. 30	11	238
	St. Elias Ocean Products			
2, 4	Cordova	Sept. 1 - Oct. 20	1-3/4	35

* See Table I

** Seasons are state regulated and may vary from year to year.

The major source of wastes is from the butchering operation where backs and viscera fare removed and where the crab blood accumulates. Cooking, cooling, and wash waters contain solids and organics to a lesser degree. Waste shells and some waste meat result from the meat extraction operation.

Figure 2 shows the steps in the processing of crab and the types and sources of wastes generated during the processing.

Waste Quantities. Quantities of crab waste are given for each crab processor in Table VIII. These were calculated in the same manner as the salmon waste quantities given in Table II except that values for COD and total dry solids of 0.10 and 0.14, respectively, were used. These values are for king crab and are used for all processors since the majority of crab processed at the plants visited is king crab and values for dungeness crab are higher. The calculated quantities of crab wastes should generally be considered with the same limitations as the salmon waste quantities. No large production peak within the season characterizes the crab season as it does in the salmon season, but daily waste discharge figures should still be considered as rough estimates.

The majority of crab processors recovered shoulder meat along with the leg meat. These processors recovered from 20 - 25% of each crab while processors who did not recover the shoulder meat recovered only 12% of the crab. The remaining 75 - 80% and 88% of the crabs are discharged as wastes.

Table VIII

Crab Processor's Waste Quantities

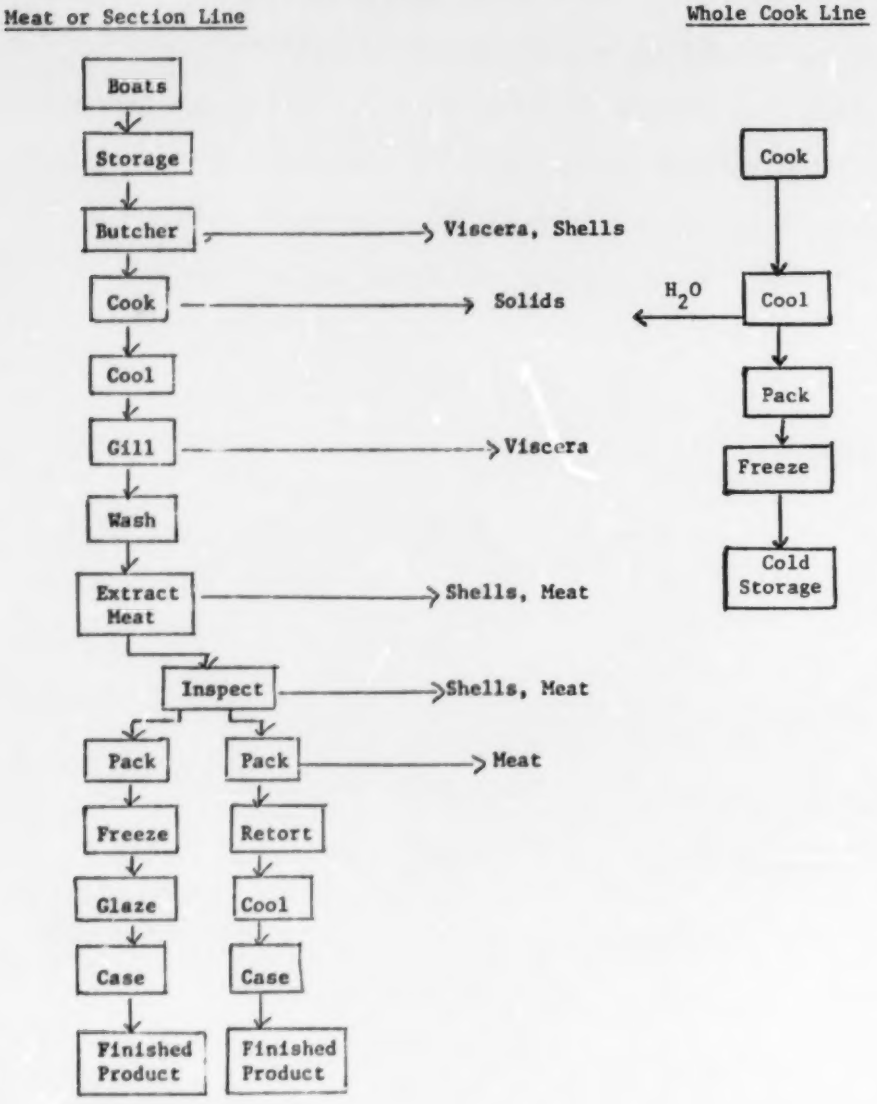
Company - Location	Methods of Waste Disposal	Green Crab * Processed (lbs)	% Waste	Waste Quantities (lbs) Wet Weight Annual	Wet Weight Daily	COD Annual	COD Daily	Total Dry Solids Annual	Total Dry Solids Daily
Alaska Glacier Seafood Petersburg	Grinding, discharge at dock face	125,000	76.5%	95,600	--	12,500	--	17,500	--
American Freezerships M/V Terresa Lee- Akutan Adak	Grind, discharge 60' deep	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA
Pan Alaska Seafoods Unalaska	Grind, discharge at dock face	11,900,000	77%	9,160,000	61,000	1,190,000	7,900	1,670,000	11,000
Peter Pan Seafoods King Cove	Grind, discharge at dock face	6,000,000	80%	4,800,000	54,000	600,000	6,700	840,000	9,400
Pt. Adams Packing M/V Northgate Dutch Harbor Adak	Grind, discharge overboard	2,107,000 3,511,000	80% 80%	1,690,000 2,810,000	27,000 27,000	211,000 351,000	3,300 3,300	295,000 492,000	4,700 4,700
Pt. Chehalis Packers Cordova	Discharge under dock unground	4,500,000	88%	3,950,000	17,000	450,000	1,900	630,000	2,700
St. Elias Ocean Products Cordova	Discharge unground at boatside	308,000	75%	231,000	7,000	31,000	900	43,000	1,200
Vitafood Products M/V Viceroy Dutch Harbor Adak	Grind, discharge overboard	4,876,000 3,384,000	77% 77%	3,750,000 2,610,000	54,000 25,000	487,000 338,000	7,000 3,000	683,000 474,000	9,800 4,500
Wakefield Fisheries M/V Akutan Akutan Adak	Grind, discharge overboard	1,300,000 4,000,000	80% 80%	1,040,000 3,200,000	16,000 36,000	130,000 400,000	2,000 4,400	182,000 560,000	2,800 6,200
Sand Point	Grind, discharge at dock face	7,000,000	75%	5,250,000	29,000	700,000	3,900	980,000	5,400
Whitney Fidalgo Seafoods Petersburg	Discharge unground Wastes under dock	7,000,000	NA	NA	NA		NA	NA	NA

* Largest production within last five years

NA - Not Available

Figure 2

Crab Processing, Types and Sources of Wastes



The quantities of water used by the crab processors visited were generally unknown. Only one processor of those visited, a floater, had a metered water supply. It used approximately 3,500 gallons per day of fresh water and 864,000 gallons per day of salt water.
Based on production averages of three years for this single processor, it is very roughly estimated that 37 gallons of water (fresh and salt) are used for every pound of green (raw) crab processed.

The following tables on waste quantities were derived from Table VIII:

Table IX

Estimated Annual Waste from Crab Processors ** in Pounds

Location	# of Processors	Wet Weight	COD	Total Dry Solids
Dutch Harbor	3	14,600,000	1,890,000	2,640,000
Adak	3 *	8,610,000	1,090,000	1,530,000
Cordova	2	4,180,000	480,000	673,000

Table X

Estimated Daily Waste from Crab Processors ** in Pounds

Location	# of Processors	Wet Weight	COD	Total Dry Solids
Dutch Harbor	3	141,000	18,000	26,000
Adak	3 *	87,000	11,000	15,000
Cordova	2	23,000	3,000	4,000

* Data available from only three of the four processors operating in Adak.

** These processors are noted because they discharge into the same bay or cove.

Shrimp Industry

Only two shrimp processors were visited during this survey and neither was processing shrimp at the time of the visit. Thus, observations of the shrimp industry were relatively limited.

The operating seasons in 1971 and plant location codes for the two shrimp processors visited are shown in Table XI.

Shrimp Processing and Sources of Waste. Shrimp are peeled and picked either by hand or by mechanical means. One of the shrimp processors that was visited used mechanical peelers and the other was a small handpick operation only processes 100 to 400 pounds of raw shrimp per day per picker. The major source of waste is in this peeling operation. Figure 3 and Figure 4 show the steps in shrimp processing and the types and sources of wastes for a mechanical peeling operation and for a handpick operation, respectively.

Waste Quantities. The quantities of shrimp waste for the two shrimp processors visited are given in Table XII and were calculated in the same manner as values in Table II and VIII using values of 0.31 and 0.30 for COD and total dry solids, respectively. Quantities in Table XII should be considered with the same general limitations as the salmon and crab waste quantities given in Table II and VIII.

Table XI

SHRIMP INDUSTRY

Code *	Company Location	Season	# of Months	# of Processing Days
1, 3	Peter Pan Seafoods Squaw Harbor	July 1 - April 30	10	195
2, 3	Alaska Glacier Seafood Petersburg	May 1 - Feb. 15 **		199 **

* See Table I

** Combined crab and shrimp seasons

Figure 3

Shrimp Processing, Types and Sources of Wastes
(Shrimp Mechanical Peeling)

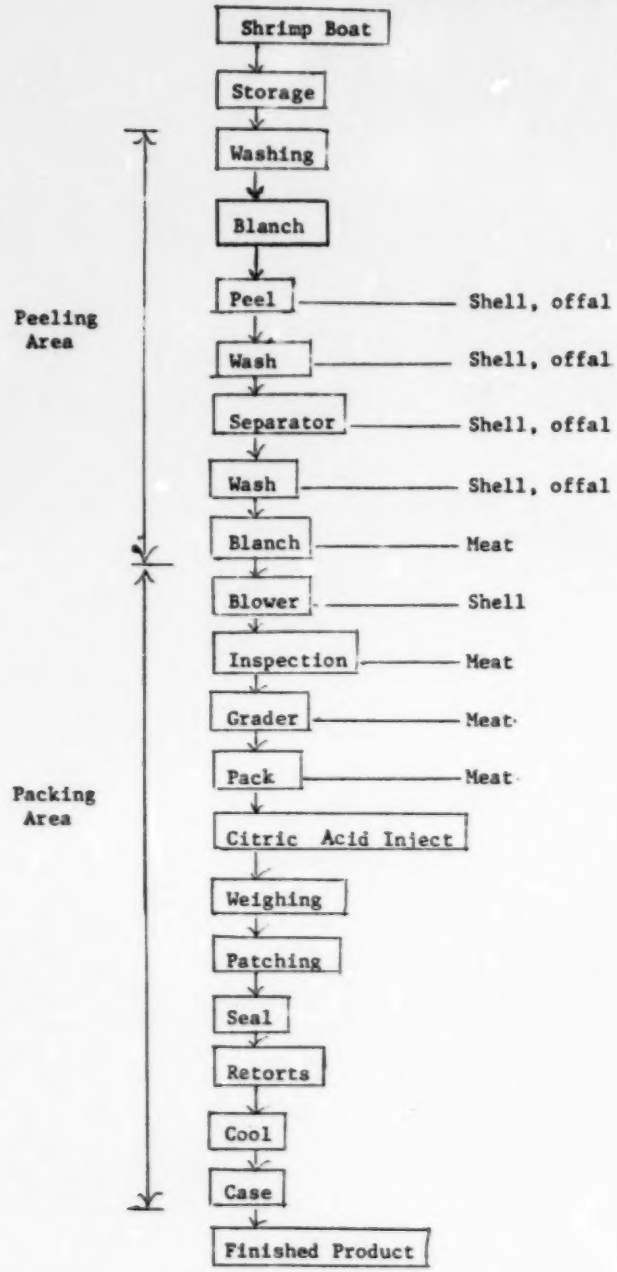


Figure 4

Shrimp Processing, Types and Sources of Wastes

(Shrimp Hand Picking)

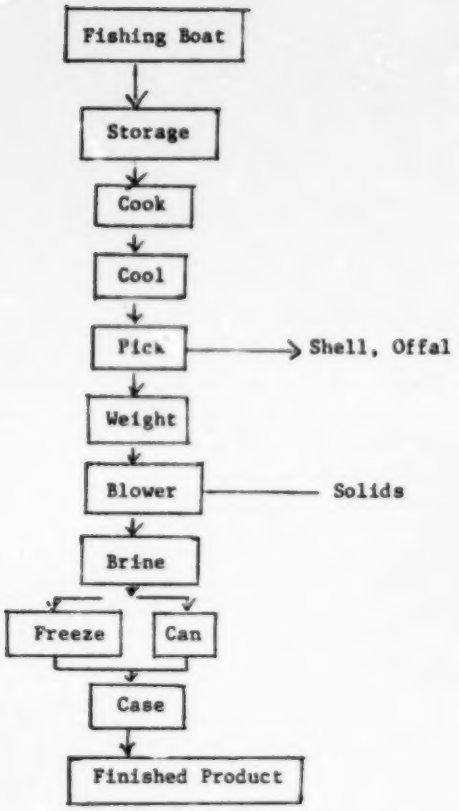


Table XII

Shrimp Processor's Waste Quantities

Company Location	Methods of Waste Disposal	Raw Shrimp Processed (lbs)	% Waste	Waste Quantities (lbs)					
				Wet Weight		COD		Total Dry Solids	
				Annual	Daily	Annual	Daily	Annual	Daily
Alaska Glacier Seafood Petersburg	Grinding, discharge at dock face	150,000	81%	121,000	--	47,000	--	45,000	--
Peter Pan Seafoods Squaw Harbor	Outfall at dock	7,880,000	80%	6,300,000	32,000	2,443,000	13,000	2,360,000	12,000

METHODS OF SEAFOOD WASTE DISPOSAL

There was no waste treatment practiced at any of the plants visited. Wastes were ground at one-half of the plants visited.

There are three basic methods used by the seafood processors for disposal of wastes.

1. Discharging wastes whole:

   Wastes are discharged unground either by (a) dropping through holes in the floor to the waters below, (b) fluming by gravity flow to a central discharge point above the water level under the plant dock or at the dock face, or (c) combinations of (a) and (b).

2. Grinding Wastes:

   All or a portion of the seafood wastes are flumed to a grinder. Some salmon canneries only grind the fish heads and leave tails, fins, and viscera whole which are discharged as in (1) above. Ground wastes are then either discharged by (a) gravity flow to a discharge point under the cannery dock or at the dock face or (b) pumping to a discharge point beyond the dock face for discharge on the surface or at depth.

3. Barging (practice applies to salmon processors only):

   Unground wastes are flumed by gravity flow to a barge which is usually emptied daily. Barged wastes are generally dumped at least one half mile from the plant.

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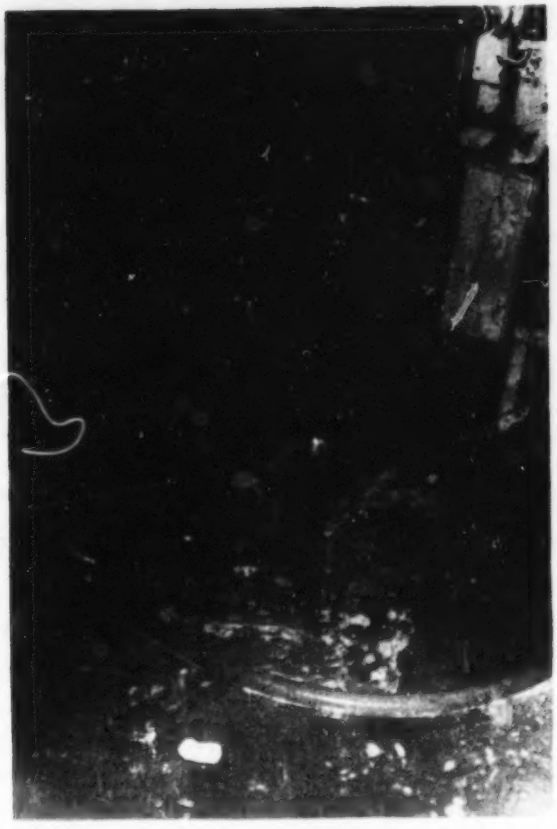


Inside a salmon Cannery - a typical
"hole in the floor" wastewater disposal method.

Salmon Cannery Wastewater Discharge below the Cannerydock.

Several specific wastes from processing salmon are all disposed of by essentially the same methods at all of the canneries visited. In the egg house, the brine used for processing salmon eggs is discharged through holes in the floor to the water below. Also, water which is used for sluicing and for cooling in the retorts is discharged directly to the receiving waters.

Depending upon the state regulated season, the crab processors which operate in the Aleutians on ships usually process king crab at Dutch Harbor and Akutan from July through October. They then move to Adak where they process king crab from November through the middle of March.

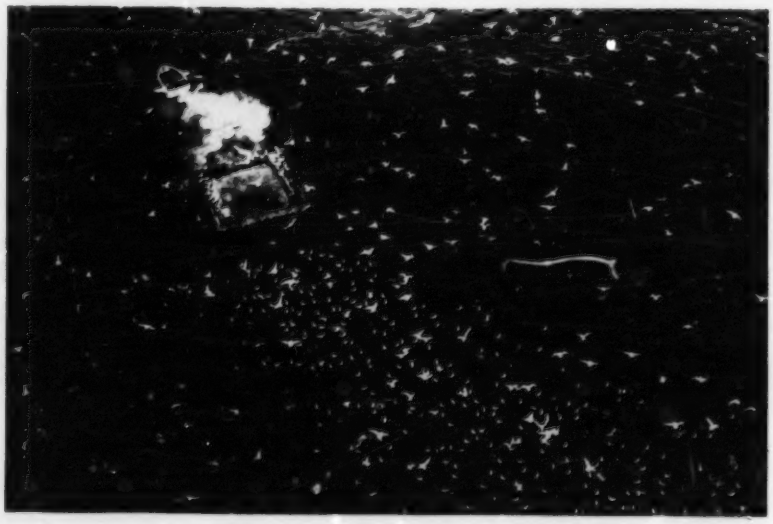
The crab processors which operate at Adak aboard ships are required by the U.S. Navy to grind all of their crab wastes and discharge them at 42 feet of depth. The shipboard processors which were visited at Akutan and Dutch Harbor either had installed or were installing waste disposal systems which would meet these Navy requirements.

Processors that are barging wastes away from the plant are usually doing so to eliminate waste accumulations in the immediate area of the cannery.

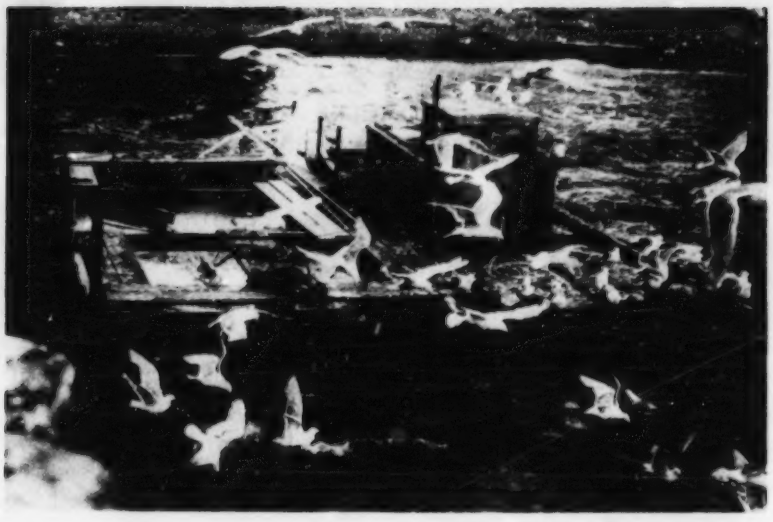
Three different kinds of barges were observed. Two processors were using barges with nylon mesh bottoms which had 2-1/2 inch square openings. The effect of this type of bottom was to catch all the larger solids while allowing smaller solids to pass through the mesh to the surrounding waters. This type of barge is emptied by releasing two corners of the nylon mesh while being towed. This acts to flush out the wastes. Another

type of barge is constructed with wood sides with relatively large cracks which allows smaller solids to pass out the barge while withholding the larger solids. This type of barge is emptied by opening doors in the front and back of the barge while being towed and allowing wastes to be flushed out. Wastes are dewatered by an elevator system before being dumped on the third type of barge that was observed. These wastes are then flushed from the barge using high pressure hoses.

Salmon Cannery and Waste Disposal Barge. This type of barge has a nylon mesh bottom which keeps the larger salmon waste parts within the barge. Smaller parts are allowed to pass through the mesh to the surrounding waters.



Discharging salmon wastes from the above type of barge.



Wooden type barge used for disposal of larger salmon waste parts.

ENVIRONMENTAL EFFECTS OF SEAFOOD WASTE DISPOSAL

Environmental effects resulting from seafood processing waste disposal were evaluated mostly by visual means. The scope of the survey limited field work and restricted analytical procedures to a minimum.

Aesthetic problems such as floating seafood wastes, foaming, and bloody water were observed at nearly all of the seafood processors. For the most part, aesthetic problems existed only during the time when wastes were being discharged and several hours afterward.

Effects upon the environment, which were observed as a result of seafood processing waste disposal, included the following: accumulation of seafood wastes on the bottom of the bay or estuary producing sludge beds, accumulation of seafood wastes upon the beaches, bloody water, foaming, floating seafood wastes, and aesthetic problems. All of the above effects are violations of Alaska Water Quality Standards.

The existence of the above effects and the severity of the associated problems depended upon the plant location, the method of waste disposal, the tidal action, and the currents. For example, some plants are located on bays or estuaries that have relatively high ebb and flood tidal currents flowing past the plant which serve to disperse the wastes.

Based strictly on visual observation, it appeared that ground wastes dispersed better and more rapidly than did unground wastes. However, concrete conclusions cannot be made without further investigations into dispersal of ground and unground wastes.

The discharge of cooling water, sluice water, and egg processing

brine directly to the waters below the salmon canneries plants was observed, but no attempt was made to check on dispersal or effects.

The effects of barging operations were not observed except for one aerial observation. Further investigation is needed.

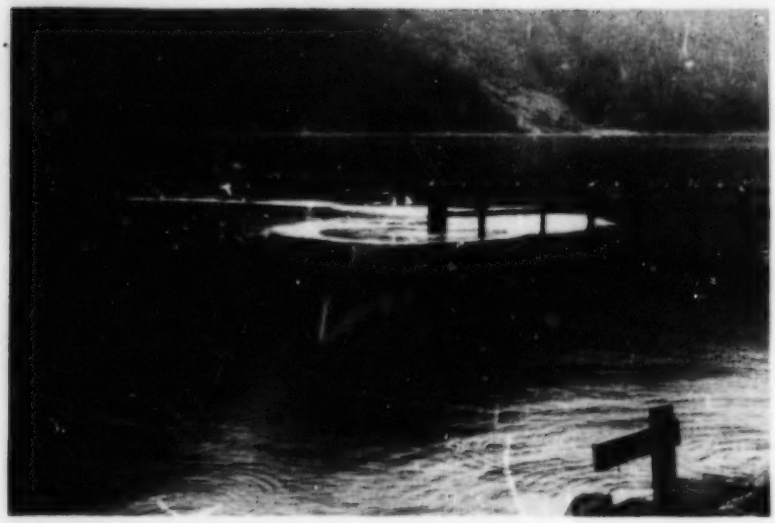
At several locations where processors were discharging salmon wastes, bottom samples were taken with a Peterson dredge. Dissolved oxygen was measured at two locations where sludge beds were found. Measurements of dissolved oxygen in several places at several depths showed 10.5 ppm and no significant oxygen depression. However, no conclusions should be drawn from these findings because of the limited number of tests.

The worst condition observed was at Dutch Harbor where crab wastes were being ground and discharged out the side of a floating processor moored in relatively calm water. Ground crab shells were observed, accumulated in a pile above the water level in at least 15 feet of water. The grinder was not working very well and pieces of shell which were three inches in size were commonly passing through the grinder untouched. It was reported that divers had observed a layer of murky, floc-like material about one foot thick on the bottom covering a large area in the vicinity of the ship. Also, floating solids and foaming was observed in the vicinity of the processor as a result of the discharge.

At Cordova, the superintendent of one crab processing operation reported that crab shells during the last season were piled at least 20 feet deep under the processing building built over the water on pilings. Crab wastes are disposed of by dumping unground wastes

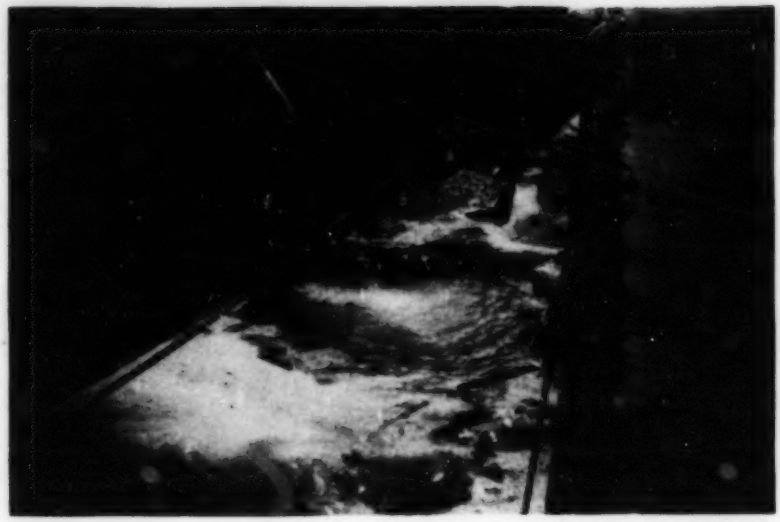
directly below the building. The superintendent reported that the shells were gone within four months due to tidal action. However, although the shells had apparently been dispersed by tidal actions, the beaches in the vicinity of the plant did have accumulations of small pieces of crab shells from previous processing seasons.

Salmon wastes dredged from the bottom in the vicinity of a salmon cannery outfall.



Typical salmon cannery wastewater discharge.

Salmon cannery and wastewater discharge.



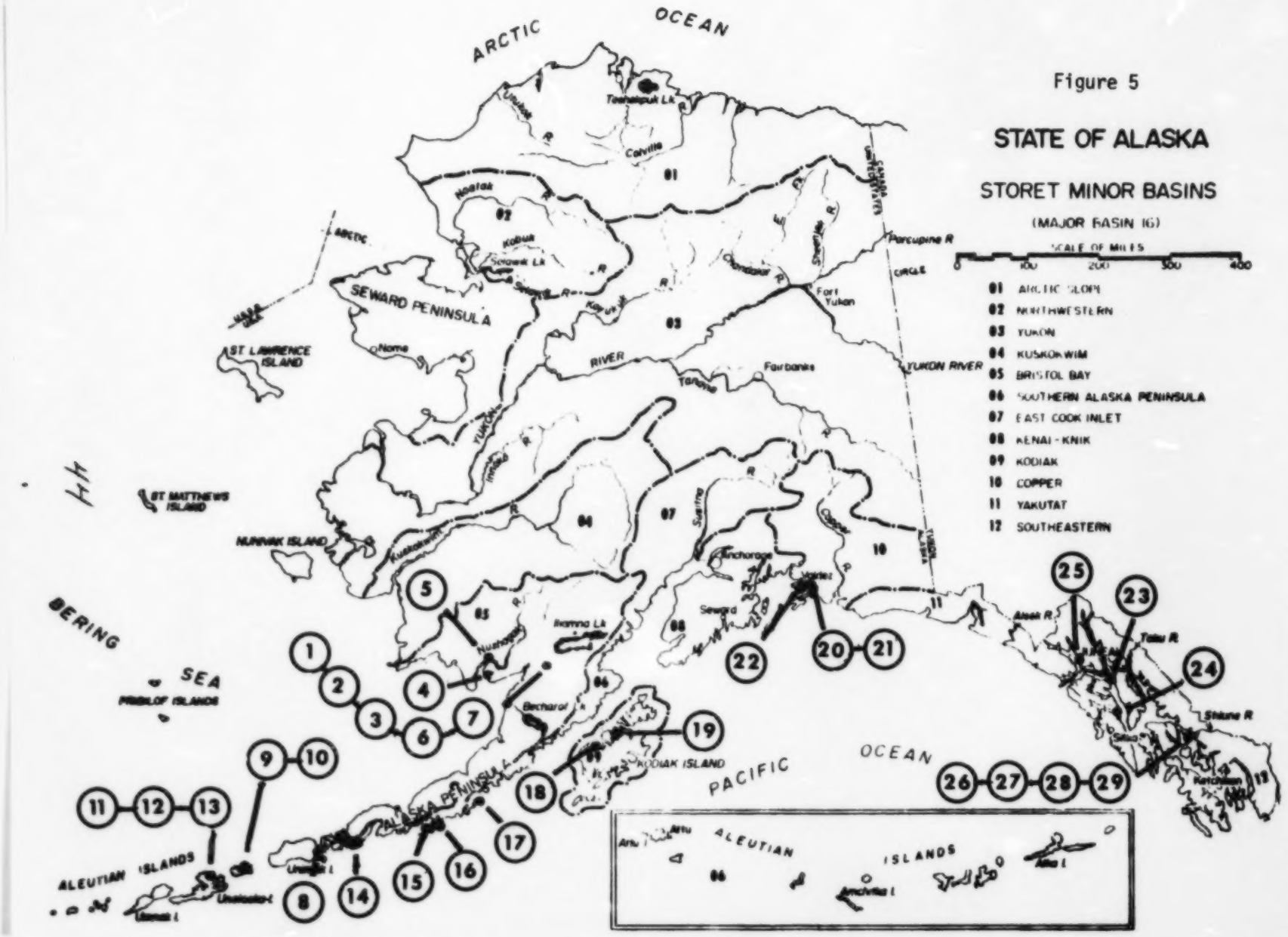
Ground crab shells accumulated alongside of a floating crab processor as a result of its crab waste discharge.

TABLE XIII

PROCESSORS VISITED AND LOCATIONS

	Processor	Date Visited	Location
1.	Red Salmon Company	Jul 16 - 17, 1971	Naknek
2.	Nelbro	Jul 17	Naknek
3.	Whitney Fidalgo	Jul 17	Naknek
4.	Columbia Ward	Jul 18	Ekuk
5.	Peter Pan Seafoods	Jul 18	Dillingham
6.	Bumble Bee	Jul 19	South Naknek
7.	Alaska Packers	Jul 19	South Naknek
8.	Peter Pan Seafoods	Jul 19 - 20	False Pass
9.	Wakefield (M/V Akutan)	Jul 20	Akutan
10.	American Freezerships (M/V Therresa Lee)	Jul 20	Akutan
11.	Pan Alaska Fisheries	Jul 20	Dutch Harbor
12.	Point Adams Packing Co. (M/V Northgate)	Jul 21	Dutch Harbor
13.	Vitafoods (M/V Viceroy)	Jul 21	Dutch Harbor
14.	Peter Pan Seafoods	Jul 21	King Cove
15.	Peter Pan Seafoods	Jul 21	Squaw Harbor
16.	Wakefield	Jul 22	Sand Point
17.	Alaska Packers	Jul 23	Chignik
18.	Alaska Packers	Jul 23	Larsen Bay
19.	New England Fish Company	Jul 23	Uganik
20.	Point Chehalis Packers	Jul 28	Cordova
21.	St. Elias Ocean Products	Jul 28	Cordova
22.	Orca Pacific Packing Co.	Jul 29	Orca
23.	Peter Pan Seafoods	Aug 1	Hawk Inlet
24.	New England Fish Co.	Aug 2	Chatham
25.	Peter Pan Seafoods	Aug 2	Excursion Inlet
26.	Whitney Fidalgo	Aug 3	Petersburg
27.	Petersburg Fisheries Inc.	Aug 3	Petersburg
28.	Alaskan Glacier Seafood Company	Aug 3	Petersburg
29.	Petersburg Cold Storage	Aug 3	Petersburg

Figure 5



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